

## PATENT COOPERATION TREATY

15. Sep. 2004

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT

(PCT Rule 71.1)

To:
Hasler, Erich RIEDERER HASLER & PARTNER PATENTANWÄLTE AG Elestastrasse 8 CH-7310 Bad Ragaz SUISSE

Date of mailing (day/month/year)	13.09.2004
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Applicant's or agent's file reference 2157-8930	<b>IMPORTANT NOTIFICATION</b>
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International application No. PCT/CH 03/00366	International filing date (day/month/year) 06.06.2003	Priority date (day/month/year) 06.06.2002
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Applicant MILLER, Balthasar
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1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.
4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed inventions is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the international preliminary examining authority   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax +49 89 2399 - 4465	Authorized Officer  Fernández Gomez, L  Tel. +49 89 2399-7449	
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## PATENT COOPERATION TREATY

## PCT



## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 2157-8930	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEAA16)	
International application No. PCT/CH 03/00366	International filing date (day/month/year) 06.06.2003	Priority date (day/month/year) 06.06.2002
International Patent Classification (IPC) or both national classification and IPC D21H25/04		
Applicant MILLER, Balthasar		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.
- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).
- These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:
- I ☒ Basis of the opinion
  - II ☐ Priority
  - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
  - IV ☐ Lack of unity of invention
  - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
  - VI ☐ Certain documents cited
  - VII ☐ Certain defects in the international application
  - VIII ☐ Certain observations on the international application

Date of submission of the demand  31.12.2003	Date of completion of this report  13.09.2004
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer  Karlsson, L Telephone No. +49 89 2399-8424 

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**International application No. **PCT/CH 03/00366****I. Basis of the report**

1. With regard to the elements of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*).

**Description, Pages**

1-19 as originally filed

**Claims, Numbers**

1-29 received on 06.07.2004 with letter of 06.07.2004

**Drawings, Sheets**

1/3-3/3 as originally filed

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

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EXAMINATION REPORT**International application No. **PCT/CH 03/00366**

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes: Claims	1-18,20,21,23-29
	No: Claims	19,22
Inventive step (IS)	Yes: Claims	
	No: Claims	1-29
Industrial applicability (IA)	Yes: Claims	1-29
	No: Claims	

**2. Citations and explanations**

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/CH 03/00366

**Re Item V****Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. The present invention pertains to a process for manufacturing a fibrous, flat and electronically conducting material made of synthetic fibres, wherein the staple fibres are firstly fibrillated, the fibrillated staple fibres are formed into a continuous web using the paper manufacturing process and finally the web is calendered and carbonised/graphitized through heating to a temperature greater than 600 °C to obtain electrical conductivity. The present claim 19 refers to a fibrous, flat and porous material obtained by e.g. the process of claim 1, whereas claim 22 just refer to a non-woven fabric characterized in that the fabric comprises carbonised/graphitized polymeric fibres. The current claim 28 defines a fuel cell comprising the non-woven fabrics of the earlier defined claims. The current claim 29 refers to a use claim of the defined material as a micro porous support for a membrane.

2.1 The present claims 20 and 22 have been amended by introducing the features of the originally filed claim 21, i.e. that there is a difference in porosity between a core and a cover layer. However, presently it has not been clearly defined how said core and cover layer are related to each other. Thus, the wordings of the present claims 20 and 22, as well as 28 and 29 do not meet the requirements of Article 6 PCT.

) Further, the present claims 20 and 22, tries to define, although not presently clearly defined, the features which results from the double calendering step, whereas the current claim 1 only defines one calendering treatment. Thus, there seems to be a certain inconsistency between the essential features of claim 1 compared to the ones of product claims 20 and 22.

2.2 The technical meaning of the wording "fixed in a tenter frame prior to the carbonisation process" of claim 4 is not understood (Art.6 PCT).

3.1 D1:EP-A-0 386 633 discloses also a fibrous product which has been carbonised at a temperature of 940 °C (see example 1, claims 1-22, fig.1-2 of D1). Besides, from the disclosure of D1 it also becomes clear that the material may be mechanically compressed in order to obtain different densities throughout the thickness of the material (see e.g. examples 1-3). Needless to say, but the compression of the material certainly also influence the porosity of the material. Presently, it is not quite clear how

**INTERNATIONAL PRELIMINARY**

International application No. PCT/CH 03/00366

**EXAMINATION REPORT - SEPARATE SHEET**

the product claims 19 and 22 differs in terms of structural features from the non-woven materials of D1 and D2. Thus, it appears as the presently very generally drafted claims 19 and 22 would not be novel with regard to the disclosure of D1.

3.4 Presently it seems as the separate features of the dependent claims would not be inventive in the light of the disclosures of D1, D2 and D3:US-A-3 047 455 (see D3, claims 1-3, examples 1-5). However, a combination of the features of the dependent claims may still be novel and inventive (Art.33.2 and 33.3 PCT).

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Patent Claims

1. A process to manufacture a fibrous, flat and electronically conducting material made of synthetic fibers, in particular synthetically spun fibers (e.g. acrylic fibers), comprising the steps of
  - first fibrillating staple fibers having preferably a specific length;
  - forming the fibrillated staple fibers into a continuous web in a paper manufacturing process, preferably by means of an inclined wire wet laid paper machine, characterized in that, the continuous web is calendared at least once prior to its carbonization and then carbonized/graphitized through heating at a temperature of greater than 600 °C, to obtain electrical conductivity.
2. A process according to claim 1, characterized in that the carbonization takes place at a temperature greater than 800 °C, and very much preferred greater than 1000 °C.
3. A process according to claim 1 or 2, characterized by an initial first temperature treatment that at least partially softens or melts the fibres.
4. A process according to claim 1 or 2, characterized in that the flat material is fixed in a tenter frame prior to the carbonization process.
5. A process according to one of claims 1 to 4, characterized in that the staple fibers are suspended in a solvent, preferably water, to form a pulp and are then

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fibrillated.

5. A process according to one of claims 1 to 5, characterized in that the fibers are fibrillated in a refiner.
7. A process according to claim 5, characterized in that the pulp dilution in the refiner is approximately 0.1 to 0.01 %, preferably 0.05 to 0.02%.
8. A process according to one of claims 1 to 7, characterized in that a mixture of fibrillated and non-fibrillated fibers is used.
9. A process according to one of claims 1 to 8, characterized in that the fibrillated fibers are processed into webs with a substance weight typically between 45 to 150g/m<sup>2</sup>.
10. A process according to one of claims 1 to 9, characterized in that fibers with a Titer of up to 15 dtex maximum, preferably up to 8 dtex maximum and especially preferred with a Titer of up to 3.0 dtex maximum are used.
11. A process according to one of claims 1 to 10, characterized in that fibers with cut lengths between 4 and 40 mm, preferably between 8 and 12 mm are used to produce the continuous web.
12. A process according to one of claims 1 to 11, characterized in that synthetic fibers of at least a first and a second type are used.



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13. A process according to claim 12, characterized in that the fibers of a second type contain fractions of at least one noble metal or other additive, e.g. a synthetic additive.
14. A process according to claim 1, characterized in that the calendaring is carried out at raised temperatures.
15. A process according to one of claims 1 to 14, characterized in that the web or material is calendared at least twice prior to the carbonization and such that all of the material is densified in a first calendaring step and at least one of the two opposite paper surfaces is changed into a film-like, porous material by melting the fibrillated fibers in a second calendaring step.
16. A process according to one of claims 1 to 15, characterized in that the heat and pressure are selected such that the calendared micro porous material has pore sizes of  $< 5\mu\text{m}$ , preferably  $< 2\mu\text{m}$ .
17. A process according to one of claims 1 to 16, characterized in that synthetic fibers such as acrylic or Aramid fibers are used.
18. A process according to one of claims 1 to 17, characterized in that non-crystalline fibers are used as synthetic fibers.
19. A fibrous, flat and porous material obtained from a process according to one of claims 1 to 18 further characterized in that the material has a core having a first porosity and at least one cover layer having a second porosity, said second porosity being less porous

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than the first porosity..

20. A material according to claim 19, characterized by a fibrous core (13) and at least one micro porous flat cover layer (15) on one side of the material that is more dense than the fibrous region (13).
21. A material according to claim 19 or 20, characterized in that the surfaces of the material opposite one another are micro porous flat cover layers (15) that are more dense than the fibrous region (13).
22. Non-woven fabric comprising carbonized/graphitized polymeric fibres characterized in that the fabric has a core having a first porosity and at least one cover layer having a second porosity, said second porosity being less porous than the first porosity.
23. Non-woven fabric according to claim 22, characterized in that the fabric consists essentially of carbonized/graphitized polymeric fibres.
24. Non-woven fabric according to claim 22 or 23, characterized in that, the fabric is coated with a catalyst layer.
25. Non-woven fabric according to one of claims 22 to 24, characterized in that, the fabric is micro porous.
26. Non-woven fabric according to one of claims 22 to 25, characterized in that, the fabric is made from one single web or layer.

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27. Non-woven fabric according to one of claims 22 to 26, characterized in that, such a fabric is made from two or more single webs and laminated to a single web.
28. Fuel cells containing at least two gas diffusion layers separated by an ionically-electrically conducting layer separating wall (PEM membrane), said gas diffusion layers being coated with at least one catalyst, characterized in that,  
each gas diffusion layer is formed at least in part from a material according to one of claims 20 to 22 and a non-woven fabric according to one of claims 23 to 29, respectively.
29. Use of a material obtained according to one of claims 1 to 18 and a non-woven fabric according to one of claims 22 to 27, respectively, as a micro porous support for a membrane, in particular a PEM membrane.

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